BUNNELL-LAMMONS ENGINEERING, INC.

GEOTECHNICAL, ENVIRONMENTAL AND CONSTRUCTION MATERIALS CONSULTANTS

REPORT OF GEOLOGIC OBSERVATION OF CELL NO. 13 CONSTRUCTION

EAST CAROLINA REGIONAL MSW LANDFILL
BERTIE COUNTY, NORTH CAROLINA
SOLID WASTE PERMIT NUMBER 08-03

Prepared for:

REPUBLIC SERVICES OF NORTH CAROLINA, LLC
5111 Chin Page Road
Durham, North Carolina 27703

Prepared by:

BUNNELL-LAMMONS ENGINEERING, INC.
6004 Ponders Court
Greenville, South Carolina 29615

February 13, 2013

BLE Project Number J12-1001-71

BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL, ENVIRONMENTAL AND CONSTRUCTION MATERIALS CONSULTANTS

February 13, 2013

Republic Services of North Carolina, LLC
5111 Chin Page Road
Durham, North Carolina 27703

Attention: Mr. Matthew Einsmann, P.E.
Environmental Manager

Subject: **Report of Geologic Observation of Cell No. 13 Construction**
East Carolina Regional MSW Landfill
Bertie County, North Carolina
Solid Waste Permit Number 08-03
BLE Project Number J12-1001-71

Gentlemen:

As authorized, Bunnell-Lammons Engineering, Inc. performed field geologic observations during earthwork activities at the subject site associated with the construction of Cell No. 13. The purpose of this work was to observe and document the location, trend, and characteristics of pertinent geologic features within the Cell No. 13 footprint area. This project was required by the North Carolina Department of Environment and Natural Resources, as outlined in the Solid Waste Permit No. 08-03 issued for the landfill. The enclosed report describes the work performed and presents the results obtained.

We appreciate the opportunity to serve as your geological and construction quality assurance consultant on this project. If you have any questions, please contact us at (864) 288-1265.

Sincerely,
BUNNELL-LAMMONS ENGINEERING, INC.

NORTH CAROLINA LICENSED SEAL 1043 GEOLOGIST MARK S. PREDDY 2/13/13

Mark S. Preddy, L.G.
Senior Geologist
Licensed, North Carolina No. 1043

NORTH CAROLINA PROFESSIONAL SEAL 13814 ENGINEER DANIEL B. BUNNELL 2/13/13

Daniel B. Bunnell, P.E.
Principal Geotechnical Engineer
Registered, North Carolina No.13814

cc: Mr. William F. Hodges, P.E. – Hodges, Harbin, Newberry & Tribble, Inc.
Mr. K. Matthew Cheek, P.E. – Hodges, Harbin, Newberry & Tribble, Inc.

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6004 PONDERS COURT
GREENVILLE, SOUTH CAROLINA 29615

PHONE (864) 288-1265
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PROJECT INFORMATION

The East Carolina Regional Municipal Solid Waste (MSW) Landfill is located at 1922 Republican Road in Bertie County, 7.5 miles northwest of Windsor, North Carolina near the community of Aulander (**Figure 1**). The site consists of about 641 acres, which was formerly rural farmland and pine forest. The landfill is owned and operated by Republic Services of North Carolina, LLC (Republic).

The landfill is being developed in phases, as new solid waste cells are needed. Phases 1, 2, 3, and 4 at the landfill have been constructed and consist of existing Cells No. 3 through 12. Phase 5 will consist of two solid waste cells (Cells No. 13 and 14). Currently, Cell No. 13 is under construction (**Figure 2**).

As part of the Permit to Construct (PTC) for Phase 5 (Cells No. 13-14), partially provided in Attachment 2, Part I, 5 from North Carolina Department of Environment and Natural Resources (DENR) dated February 9, 2009 states the following:

> "A Licensed Geologist must report any pertinent geological feature(s) exposed during phase or cell excavation. Prior to placing any landfill liner, the geologist must submit to the Section Hydrogeologist a written report that includes an accurate description of the exposed geological feature(s) and effect of the geological feature(s) on the design, construction, and operation of the cell, phase, or unit."

Bunnell-Lammons Engineering, Inc. (BLE) personnel are familiar with the site and previously prepared the Site Hydrogeologic Report (Law Engineering 1992 and BLE 2003), and the Design Hydrogeologic Reports (DHRs) for Phase 1 (Law Engineering 1993), Phase 2 (Law Engineering 1994), Phase 3 (BLE 2000), and Phase 4 (BLE 2005). BLE has also performed the CQA monitoring, testing, and construction quality assurance (CQA) reporting for Cell Nos. 3 through the current cell construction. This report documents the geologic observations during the preparation of the natural or in-situ soil subgrade prior to fill soil and clay liner placement in Cell No. 13.

SITE GEOLOGY

The site is located within the Coastal Plain region in northeastern North Carolina. The Coastal Plain consists of sediments that range in age from recent to Cretaceous or older and which lie on top of "basement" or crystalline rocks that are similar or equivalent to the igneous and metamorphic rocks of the Piedmont region. The Coastal Plain sediments range in thickness from a featheredge along the western edge to several thousand feet along the coast.

In the typical Coastal Plain stratigraphic sequence, Cretaceous sediments directly overlie the basement rocks and consist of the Black Creek and Cape Fear geologic formations. Tertiary sediments, which overlie the Cretaceous formations, consist of the Yorktown and Duplin geologic formations. Near-surface geologic units at the site include the Yorktown formation, which lies unconformably on top of the Black Creek formation.

Within the zone of investigation at the site (less than 65 feet below ground surface), the subsurface geology consists of four distinct soil layers, which are part of the Tertiary Yorktown Formation (Layers I and II) and Cretaceous Black Creek Formation (Layers III and IV). Layer I is a silty clay aquitard at the ground surface which has low permeability and serves as a confining layer for the underlying Layer II sandy aquifer. Layer II is the uppermost ground-water aquifer and consists of silty sand with potentiometric levels above the base of Layer I during most of the year. Layer III is a silty clay aquitard which serves as an intervening confining unit between the uppermost aquifer (Layer II) and an underlying confined aquifer (Layer IV). Layer IV is a confined aquifer consisting of silty sand, with potentiometric levels above the base of Layer III. Layers II and IV are fully separated by Layer III across the Phase 5 area.

FIELD OBSERVATIONS

Engineers and geologists from BLE visited the site on multiple occasions during subgrade preparation. Additionally, BLE had a CQA technician on site on a full-time basis during subgrade preparation, as well as during other cell construction activities. During these visits, the exposed ground surface was observed in order to identify anomalous geologic features not identified during previous geologic investigations. The visits were conducted during the site clearing and grading activities, and at the start of fill soil placement on top of in-situ soils. Geologic site observations are described below and are shown on photographs 1 through 8 in **Appendix A.**

The "A horizon" soils were removed from the Cell No. 13 ground surface during March to August 2009 (Photographs 1-4).

There were five drainage ditches in the footprint of Cell No. 13 and its fill embankment (**Figure 3**). Runoff sediments and plant material were removed from the ditches during June of 2009, June 2010, and November 2012 (Photograph 5). The removal of the runoff sediments was performed with minimal disturbance to Layer I using a bulldozer and a trackhoe excavator. In addition, two test pits were made to explore the Layer I soils in 2010.

In accordance with the construction plans for Cell No. 13 (HHNT, June 2012), the surface water drainage ditches were backfilled with compacted clay liner soil with a permeability (K) $\leq 1.0 \times 10^{-7}$ cm/sec (Photographs 6 and 7) in 2010 and 2012. Confirmation CQA in-place density testing and undisturbed soil samples were collected at the site and tested in the laboratory during the placement of the fill soils. Twenty-two permeability test samples were obtained from varying representative depths and locations within the backfill of the drainage ditches. The permeability test results ranged from 1.0×10^{-7} to 1.6×10^{-8} cm/sec. The results of the confirmation samples will be included with BLE's CQA report for Cell 13 and they demonstrate that the drainage ditch backfill soils achieved the specified density and permeability of $K \leq 1.0 \times 10^{-7}$ cm/sec.

After removal of the topsoil, filling of the storm water ditches with compacted clay soils, and compaction of the former ground surface (Photograph 8), structural fill soil placement onto the subgrade began in November 2012.

CONCLUSIONS

The Layer I clay aquitard extends across the subgrade of Cell No. 13. Previous excavations into Layer I across the cell included two test pits and five surface water drainage ditches. As required by the DENR-approved construction plans for Cell No. 13 prepared by HHNT, the prior excavations into Layer I were backfilled with compacted clay liner quality borrow soils that have a permeability (K) $\leq 1.0 \times 10^{-7}$ cm/sec. CQA soil sample collection and testing confirmed that the backfill material was of the specified permeability. Also, the subgrade of Cell No. 13 was constructed by placing compacted structural fill soils above the existing Layer I soils. Therefore, Layer I will continue to serve as a confining layer for the Layer II aquifer. We conclude that modification of the existing *Water Quality Monitoring Plan* is not necessary.

REFERENCES

Report of Geologic and Hydrogeologic Assessment of Proposed Solid Waste Landfill, Spruill Farms Property, Law Engineering Job Number 2490472602, dated December 1, 1992.

Submittal in Response to Completeness Review by the NCSWMD, Report of Geologic and Hydrogeologic Assessment of Proposed Solid Waste Landfill, prepared by Law Engineering, Inc., Job Number 2490472605, dated April 28, 1993.

Design Hydrogeologic Report, Cells 3-6 (Phase 1), East Carolina Regional MSW Landfill, prepared by Law Engineering, Inc., Job Number 2490472607, dated July 21 and 29, 1993.

Submittal of Additional Soil Test Borings and Piezometer Data, Design Hydrogeologic Report, Cells 3-6 (Phase I), prepared by Law Engineering, Inc., Job Number 2490472607, dated July 21, 1993.

Site Transition Plan, East Carolina Regional MSW Landfill, prepared by Law Engineering, Inc., Job Number 249472618, dated March 31, 1994 and April 29, 1994.

Design Hydrogeologic Report, Cells 7 and 8 (Phase 2), East Carolina Regional MSW Landfill, prepared by Law Engineering, Inc., Job Number 30220-5-4726.36, dated March 12, 1996 and revised August 7, 1996.

Design Hydrogeologic Report, Cells 9-10 (Phase 3), East Carolina Regional MSW Landfill, prepared by BLE, Project Number J98-1001-18, dated January 25, 2000.

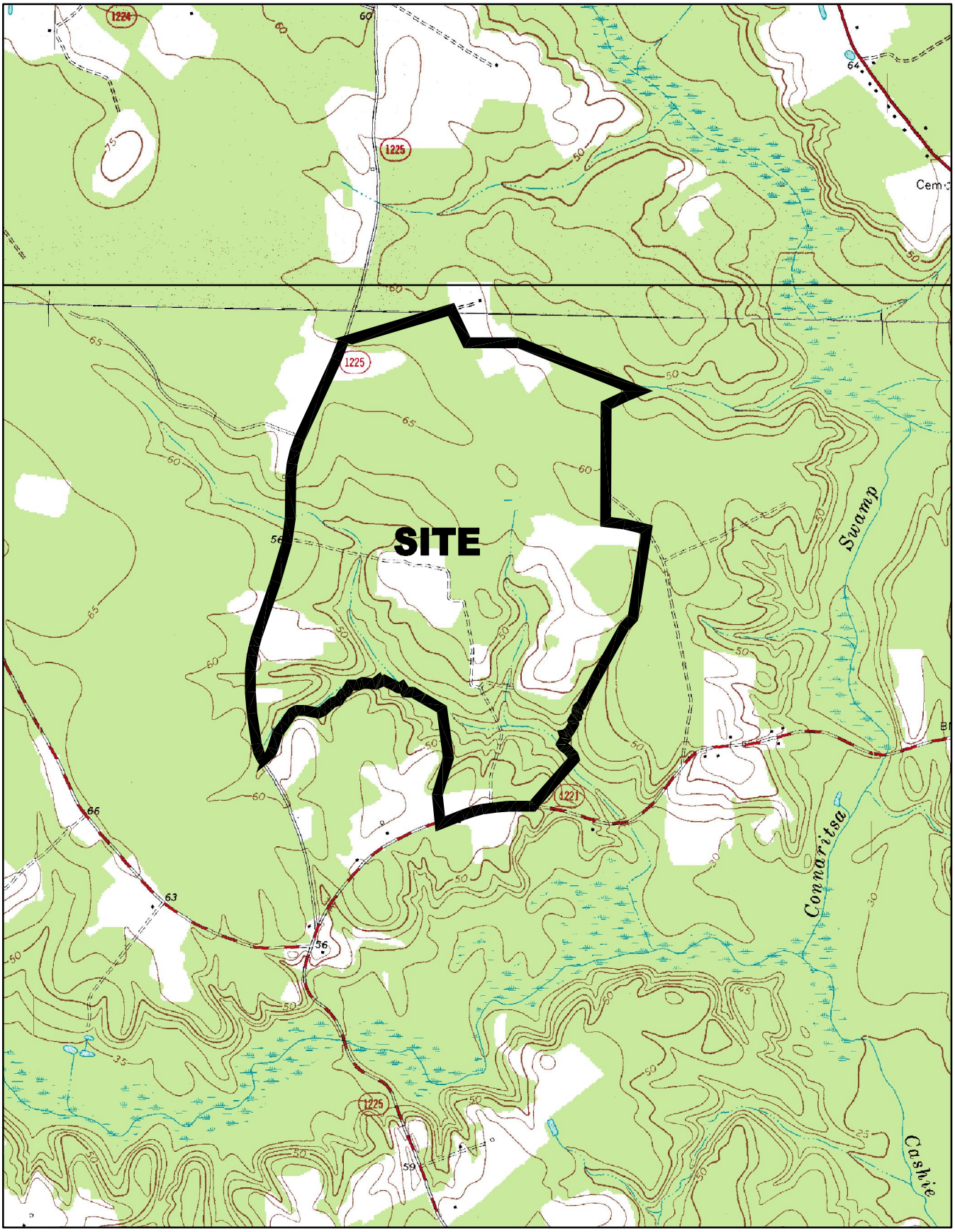
Site Hydrogeologic Report, Expanded East Carolina Regional MSW Landfill, prepared by BLE, Project Number J96-1001-03, dated July 16, 1998 (revised April 11, 2003).

Design Hydrogeologic Report, Phase 4 (Cells 11 and 12), East Carolina Regional MSW Landfill, prepared by BLE, Project Number J04-1001-46, dated January 7, 2005 (revised June 3, 2005).

Permit to Construct, Municipal Solid Waste Landfill, Phase 5 – Cells 13 and 14, East Carolina Regional Landfill, DENR, dated February 9, 2009.

Construction project documents titled *Construction of Cell No. 13, East Carolina Regional MSW Landfill, for Republic Services of North Carolina, LLC,* prepared by HHNT, Project Number 6703-419-01, dated June 2012.

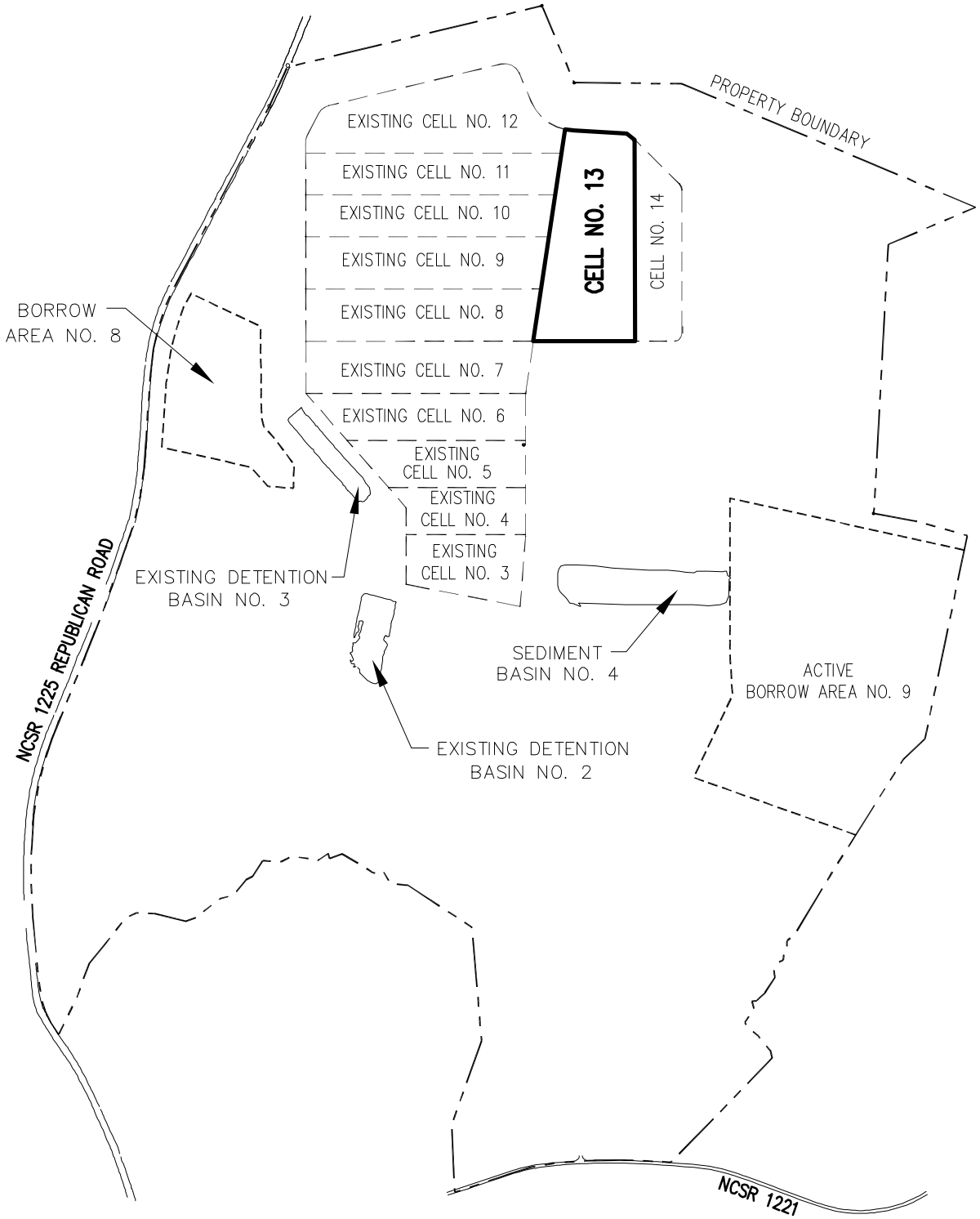
FIGURES



REFERENCE:
USGS TOPOGRAPHIC MAP, 7.5 MINUTE SERIES,
AULANDER AND REPUBLICAN, N.C. QUADRANGLES, 1972 AND 1978.

DRAWN: AEH	DATE: 02-13-13	BLE inc. BUNNELL-LAMMONS ENGINEERING, INC. 6004 PONDERS COURT GREENVILLE, SOUTH CAROLINA 29615 PHONE: (864)288-1265 FAX: (864)288-4430	FIGURE 1
CHECKED: MSP	CAD: ECLF71-SLM		
APPROVED:	JOB NO: J12-1001-71		

SITE LOCATION MAP
EAST CAROLINA LANDFILL
BERTIE COUNTY, NORTH CAROLINA



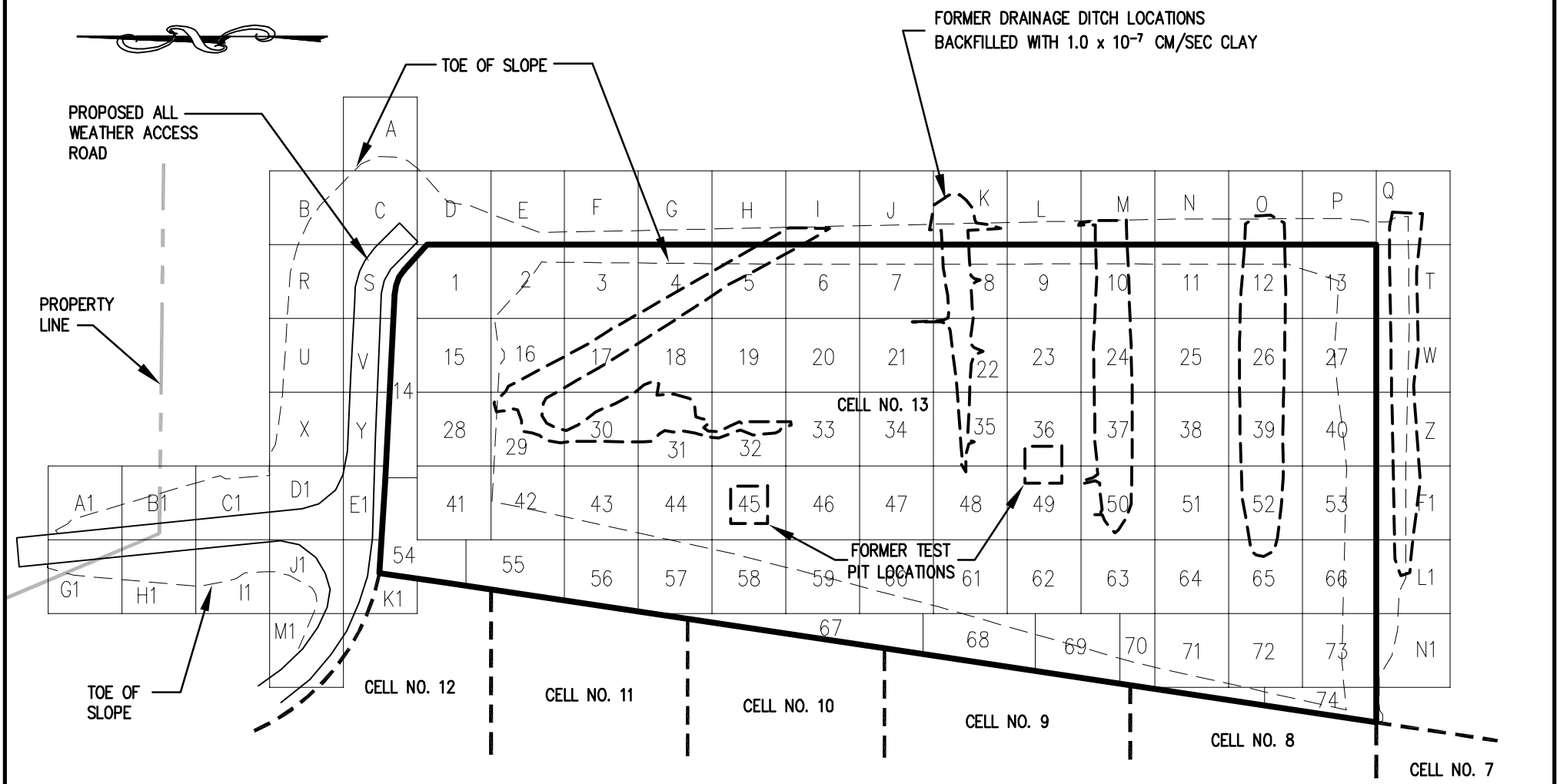
1000 500 0 1000 2000

APPROXIMATE SCALE IN FEET

REFERENCE:
DRAWING TITLED "ENVIRONMENTAL MONITORING PLAN" BY HODGES, HARBIN, NEWBERRY AND TRIBBLE, INC. DATED 12-21-07.

DRAWN: ACE	DATE: 02-13-13	BUNNELL-LAMMONS ENGINEERING, INC.	FIGURE
CHECKED: TWM	CAD: ECLF71-LAYOUT	6004 PONDERS COURT GREENVILLE, SOUTH CAROLINA 29615 PHONE: (864)288-1265 FAX: (864)288-4430	2
APPROVED:	JOB NO: J12-1001-71		

SITE LAYOUT MAP
CELL NO. 13
EAST CAROLINA LANDFILL
BERTIE COUNTY, NORTH CAROLINA



LEGEND

20 — GRID REFERENCE NUMBER OR LETTER FOR TESTING

20 — GRID AREA ≤ 10,000 SF (100' x 100')

200 100 0 200 400

APPROXIMATE SCALE IN FEET

TOTAL AREA OF CELL NO. 13
= 730,859 S.F.
= 16.8 ACRES

REFERENCE:
DRAWING TITLED "TOP OF CLAY LINER GRADING PLAN" BY HODGES, HARBIN, NEWBERRY AND TRIBBLE, INC. DATED 6-27-2012.

DRAWN: ACE	DATE: 02-13-13	BUNNELL-LAMMONS ENGINEERING, INC.	FIGURE
CHECKED: MSP	CAD: ECLF71-GEO OB CELL 13	6004 PONDERS COURT GREENVILLE, SOUTH CAROLINA 29615 PHONE: (864)288-1265 FAX: (864)288-4430	CELL NO. 13 LAYOUT EAST CAROLINA LANDFILL BERTIE COUNTY, NORTH CAROLINA
APPROVED:	JOB NO: J12-1001-71		3

APPENDIX A
Photographs

Photograph 1: (March 2009) Cell No. 13 subgrade following clearing and prior to topsoil removal and placement of compacted fill. Photograph taken facing east.

Photograph 2: (March 2009) Cell No. 13 subgrade following clearing and prior to topsoil removal and placement of compacted fill. Photograph taken facing east.

Photograph 3: (June 2009) Subgrade after the removal of the topsoil.
Photograph taken facing southeast.

Photograph 4: (August 2009) Subgrade after the removal of the topsoil.
Photograph taken facing southeast.

Photograph 5: (November 2012) Removal of loose sediments and organic matter from a drainage ditch. Photograph taken facing southeast.

Photograph 6: (June 2010) Filling and compacting of clay soils along a former drainage ditch location. Photograph taken facing south.

Photograph 7: (November 2012) Filling and compacting of clay soils along a former drainage ditch location. Photograph taken facing east.

Photograph 8: (November 2012) Subgrade prior to structural fill soil placement. Photograph taken facing north.